



“ULTRASOUND GUIDED SUPRACLAVICULAR BLOCK-COMPARISON BETWEEN SINGLE POINT AND DOUBLE POINT INJECTION TECHNIQUE: A PROSPECTIVE RANDOMISED DOUBLE BLIND CLINICAL STUDY”

Anesthesiology

Dr Panjari Shah*	Senior resident, Department of Anaesthesiology, Medical college and SSG hospital, Vadodara. *Corresponding Author
Dr Himani Patel	Senior resident, Department of Anaesthesiology, Medical college and SSG hospital, Vadodara.
Dr Sharmy Macwan	Senior resident, Department of Anaesthesiology, Medical college and SSG hospital, Vadodara.

ABSTRACT

Background and Aims: This clinical study was conducted to compare the single-point and double-point injection techniques of ultrasound-guided supraclavicular block with regard to the block success rate, total procedural time, onset and duration of sensory and motor block as well complications. **Material and Methods:** A total of 60 ASA I and II patients between 20 to 60 years of age group, with BMI ≤ 30 kg/m² posted for elective forearm surgeries were randomly divided into two groups: group SP (single-point injection technique) and group DP (double-point injection technique). Brachial plexus was located using ultrasound and needle was inserted using In-plane technique from lateral to medial side. In group DP, 30 ml of inj. Levobupivacaine 0.5% was deposited as 15 ml each in superior part of brachial plexus i.e., 11 o'clock position and in corner pocket i.e., at 7 o'clock position with respect to subclavian artery, while in group SP the total volume of drug was deposited in the superior part of plexus. Adequacy of block effect was ensured by assessing the dermatomal distribution of ulnar, radial, median and musculocutaneous nerve. Total Procedural time, onset and duration of block and complications if any were noted. **Results:** Group DP had significantly higher success rate (93.4% vs. 80%; $P < 0.0001$), faster onset and longer duration of sensory and motor block compared to group SP which had significantly shorter total procedural time. (10.7 $\pm$ 0.86 vs. 14.8 $\pm$ 0.83 mins; $P < 0.0001$). Low success rate observed in group SP is attributed to ulnar nerve sparing. **Conclusion:** The success rate in terms of blocking of all four nerves, onset and duration of sensory and motor block was significantly high in double-point injection technique at the cost of longer procedural time.

KEYWORDS

Ultrasound, Supraclavicular Block, Corner Pocket, Ulnar Nerve

1. INTRODUCTION

Peripheral nerve blocks have become an excellent anaesthetic option for limb surgeries to general anaesthesia for providing superior analgesia; less side effects and expedited hospital discharge.⁽¹⁾

The brachial plexus block is commonly performed to provide anaesthesia for upper limb surgeries. Brachial plexus can be blocked at different levels using different approaches such as interscalene, supraclavicular, infraclavicular and axillary approaches.

Supraclavicular approach is most popular among anaesthesiologists for elbow and forearm surgeries. In this approach the drug is deposited at the brachial plexus trunk where almost the entire sensory, motor and sympathetic innervation of the upper extremity is carried in just three nerve structures in a small area giving rise to a very dense blockade,⁽²⁾ hence it is often called as the “spinal of the arm”.⁽³⁾

Potential advantages of using ultrasound guidance in brachial plexus block include direct visualization of the subclavian artery and first rib; facilitating identification of brachial plexus, real-time visualization of the needle tip and spread of drug during injection with possibility of repositioning of the needle thus avoidance of intraneuronal or intravascular injection, direct visualization of pleura thus avoidance of pneumothorax, Possible reduction in the dose of local anaesthetic, faster sensory onset time and longer duration of block effect.⁽⁴⁾

Different techniques are being practised for depositing the drug around the brachial plexus such as single point, double point and multiple point injection technique.⁽²⁾ Multiple point injection technique is popular among these. However multiple punctures while performing the block can increase the incidence of nerve injury as shown in many studies.^(5,6,7)

This complication can be minimized by decreasing the number of pricks attempted while giving the block. This can be an advantage with single point technique because the conventional single point injection technique requires deposition of drug in the superolateral aspect of subclavian artery but it usually fails to block the lower trunk as it is situated at medial and inferior aspect; which subsequently results in inadequate ulnar nerve blockade while double point injection technique involves deposition of drug in the “corner pocket” formed between the subclavian artery and first rib, resulting in less occurrence of ulnar nerve sparing.^(8,9)

Various studies have been conducted to compare the efficacy of single point injection technique with double point injection technique of ultrasound guided supraclavicular block. Some of these studies observed that the success rates in both the mentioned techniques were comparable.^(10,11,12)

While others concluded that there is a significant advantage of double point injection technique over single point injection technique.^(2,7,13)

So, we conducted this study to compare the rate of success in terms of blocking all four nerves using ultrasound guided single point and double point injection technique.

Our **primary objective** was to compare rate of successful block in terms of blocking of all four nerves between two groups and **secondary objectives** were to compare procedure time, sensory and motor block characteristics, hemodynamic parameters and complications between two groups.

2. METHODOLOGY

This prospective, randomized, double blind clinical study was carried out after taking permission from Institutional ethics committee for biomedical and health research (No. IECBHR/68-2021), in the Department of Anesthesiology, Govt. Medical College and S.S.G. Hospital, Baroda, between the periods of April 2021 to November 2021. CTRI Registration was obtained (No: CTRI/2021/06/034329)

Inclusion Criteria:

- Age— From 20-60 years of either gender.
- BMI $< \text{or} = 30$ kg/m²
- ASA Physical status – I/II
- Patient posted for elective forearm surgery.
- Patient able to give written & informed consent.

Exclusion Criteria:

- Patient not willing for procedure.
- Patients with coagulopathy, pre-existing Neuropathy and nerve injury and local site infection.
- Hypersensitivity to local anesthetic drug.
- Patients with significant h/o drug or alcohol abuse or psychiatric illness.
- Pregnant, lactating mother

To have a power of study of 80% (beta error of 0.2) and two sided Confidence interval of 95% (alpha error of 0.05) in our study effective sample size came to 30 in each group.

Patients were visited a day before surgery for pre-anaesthetic checkups and preoperative advice.

Informed and written consent was obtained from all patients enrolled in study and was kept nil orally for 6 to 8 hours.

On the day of surgery, necessary OT preparation was done, patients were re-evaluated and monitored for baseline parameters (pulse rate, blood pressure, Electrocardiogram, Oxygen saturation. Good venous access was secured on non-operative limb and inj. Ringer lactate/Normal saline was started. Patients were premedicated with Inj. Ondansetron 0.08 mg/kg IV, Inj. Midazolam 0.02mg/kg IV 5 minutes before induction. For the procedure, patient was positioned supine with a small roll beneath the shoulder and head turned to the contralateral side. The arm to be blocked was kept adducted and hand was rested over abdomen.

The patients were randomly allocated into two groups of 30 patients each using sealed envelope method.

Group SP: (Single point injection technique)

30 ml of inj. Levobupivacaine 0.5% was injected at superolateral aspect of plexus at 11 O'clock position to subclavian artery.

Group DP: (Double point injection technique)

15 ml of inj. Levobupivacaine 0.5% was injected at Corner Pocket at 7 O'clock position to subclavian artery and remaining 15 ml at superolateral aspect of plexus.

Anesthetic Procedure:

Scanning: Under all aseptic and antiseptic precaution, high frequency transducer was positioned in the transvers plane immediately proximal to the clavicle and tilted caudally to identify subclavian artery in its cross-section, the brachial plexus classically appeared as "honeycomb". Colour doppler⁽¹⁴⁾ can be used to distinguish between vascular and nerve structure.

in double point injection technique 23 g spinal needle was inserted 1-2 cm lateral to probe using in- plane technique from lateral to medial direction. Hydrodissection with 0.5-1 ml of sterile water was done to increase the acoustic mismatch and for better visualization of needle tip.⁽⁸⁾ As the needle reached to "corner pocket", formed between the subclavian artery medially and first rib inferiorly. i.e., at 7 o'clock position to subclavian artery⁽²⁾, 15 ml of drug volume was injected following repeated aspirations and the spread of drug was noted, then needle was slowly withdrawn and directed towards the superolateral aspect of the subclavian artery at 11 o'clock position and remaining 15 ml drug was injected. In single point injection technique 30 ml of inj. Levobupivacaine 0.5% was injected in superolateral aspect of the subclavian artery.

Evaluation of block:

A) Procedure Time:

The time from USG probe positioning to completion of local anaesthetic injection.

B) Sensory Blockade:

Sensory effect was checked by pinprick (23g needle) method⁽⁸⁾, after every 2 mins till 30 mins or till the required effect was achieved, whichever was early.

- Grade 0-Sharp sensation to pinprick
- Grade 1-Dull sensation to pinprick
- Grade 2-No sensation to pinprick⁽⁸⁾

Assessment was done along the dermatomal distribution of following nerves;

- Musculocutaneous nerve- Lateral aspect of forearm
- Median nerve- Volar aspect of thumb
- Radial nerve- Lateral aspect of dorsum of hand
- Ulnar nerve- Volar aspect of fifth finger

Onset time-Time after drug injection to achieve dull sensation to pin prick (grade 0 to grade 1) was considered as onset time.

Time to achieve complete sensory block-The time after drug injection to complete loss of pinprick sensation (grade 0 to grade 2) was considered as time required for complete sensory block.

Duration of Sensory block-Time from attainment of grade 2 till return of grade 0.⁽⁸⁾

C) Motor Blockade:

Motor effect was checked by Modified Bromage scale⁽⁸⁾ after every 2 min till 30 min or till the required effect was achieved, whichever was early.

- Modified Bromage scale-0 normal motor function with full flexion and extension of elbow, wrist and fingers
- Modified Bromage scale 1- decreased motor strength with ability to move the fingers only
- Modified Bromage scale 2- inability to move fingers

Assessment was done along the distribution of following nerves;

- Musculocutaneous nerve-Elbow flexion
- Median nerve- Thumb opposition
- Radial nerve- Thumb abduction
- Ulnar nerve-Thumb adduction

Onset time -Time after drug injection to achieve (grade 0 to grade 1) was considered as onset time.

Time to achieve complete motor block-The time after drug injection to complete loss of movement (grade 0 to grade 2) was considered as a time required for complete motor block.

Duration of motor block-Time from attainment of grade 2 till the return of grade 0.⁽⁸⁾

D) Assessment Of Block Success:

Complete block (Surgical block) If sensory and motor block was attained in all the dermatomes supplied by the radial, ulnar, median and musculocutaneous nerves.

Incomplete block: if any one of these dermatomes failed to show signs of sensory or motor blockade after 30 mins of local anaesthetic injection; Then a proportion of block was supplemented at the elbow or wrist; or intravenous sedation with inj. Fentanyl 1mcg/kg IV was given and the surgery was started.

Failed block: If two or more than two nerves remain spared, then the block was considered as failed block and general anaesthesia was administered.⁽¹⁵⁾ Failed blocks were not excluded.

Patients were watched for vital parameters (pulse rate, mean blood pressure, Spo2) immediately after giving block; at 5th minute, every 10 minutes till 1 hour, every 20 minutes till 2 hours and then every 30 minutes till the end of surgery and in postoperative period vitals was monitored at 1st, 2nd, 4th, 6th, 10th, 14th, 18th and at 24th hour.

And also for any possible complications like bradycardia, hypotension, local anaesthetic toxicity, pneumothorax, horners syndrome, phrenic nerve block and recurrent laryngeal nerve palsy perioperatively.

3. RESULTS:

The demographic profile (age, gender, height, weight, BMI and ASA) of the two groups was comparable [Table 1]. Block procedure time was longer in group DP, $P < 0.0001$ [Table 2].

The onset of sensory block was faster in group DP with a significantly longer duration of sensory block compared to group SP, $P < 0.0001$ [Table 3]. The onset of motor block was significantly faster in group DP with prolonged motor block duration compared to group SP, $P < 0.0001$ [Table 4]. The success rate of block was significantly high in group DP than in group SP (93.4% vs. 80%), $P < 0.0001$ [Table 5]. Two patients in group DP and six in group SP had incomplete block because of ulnar nerve sparing. There was no failed block in either of the groups. No complications were observed in either groups.

Table 1: Demographic data

Parameter	Group SP (Mean±SD)	Group DP (Mean±SD)	p Value
Age in Years	38.94±9.9	39.36±10.39	p>0.05

Gender (Male: Female)	21:9	18:11	p>0.05
Hight in Cm	152.42±5.36	152.56±5.93	p>0.05
Weight in Kg	52.46±5.36	52.76±5.82	p>0.05
BMI in (Kg/m ²)	22.84±1.0	22.57±0.82	p>0.05
ASA (I: II)	19:11	17:13	p>0.05

Table 2: Assessment of procedure time

Parameter	Group SP (Mean±SD)	Group DP (Mean±SD)	p Value
Procedure time(mins)	10.73±0.86	14.83±0.83	p<0.0001

Table 3: Assessment of sensory block

Parameter	Group SP (Mean±SD)	Group DP (Mean±SD)	p Value
Onset of sensory block(mins)	8.8±0.84	5.16±0.74	P<0.0001
Time to achieve complete sensory block(mins)	15.83±0.76	10±0.76	P<0.0001
Duration sensory block (mins)	313.33±12.94	360.66±12.01	p<0.0001

Table 4: Assessment of motor block

Parameter	Group SP (Mean±SD)	Group DP (Mean±SD)	p Value
Onset of motor block(mins)	10.76±0.72	7.1±0.84	p<0.0001
Time to achieve complete motor block(mins)	21±0.78	15.85±0.75	p<0.0001
Duration motor block (mins)	259.33±20.95	306.33±10.33	p<0.0001

Table 5: Assessment of block success

Adequacy of block	Complete block effect (no. of patients)	Incomplete block effect (no. of patients)	Failed block (no. of patients)	Success rate (%)
Group SP	24	6	0	80%
Group DP	28	2	0	93.4%

Perioperative Hemodynamic:

In our study, we found no statistically significant difference in pulse rate, mean arterial pressure and Spo2 between two groups inter or intragroup wise in perioperative period.

4. DISCUSSION:

Ulnar nerve sparing is a common problem faced while performing supraclavicular block that results in incomplete or partial block.

Double point injection technique requires more needle passes but there is no report of increased procedural pain or nerve injury if block is performed by a skilled anaesthetist under USG guidance using hydro dissection technique, moreover, it is superior to single point injection technique.

In our study, we found that the mean procedure time was 10.73±0.86 minutes in group SP and 14.83±0.83 minutes in group DP. The reason for longer procedural time in group DP was more needle manipulation, redirection and use of hydro-dissection technique to reach the corner pocket. Our findings in this matter agree with Choudhary et al, who observed that double point injection technique has longer procedural time (14.6 mins) than single point injection technique (10.09 mins). Pallath et al observed similar results; time required to perform double point injection technique was prolonged (198.57±19.56 seconds) than single point injection technique (151.53±14.37 seconds).

While Choi et al stated no statistically significant difference between the mean procedure times of two techniques.

The mean time for onset of sensory block was 8.8±0.84 minutes in group SP and 5.16±0.74 minutes in group DP and mean time for onset of motor block was 10.76±0.72 minutes in group SP and 7.1±0.84 minutes in group DP. In double point injection technique, drug encircled the plexus faster which might have led to the faster onset of anaesthesia. Our findings in this matter agree with Choudhary et al, who observed faster sensory onset with double point injection technique (7±1.5 mins) than single point injection technique (10.7±2.7 mins) and motor onset with double point injection technique (11.1±2.8 mins) than single point injection technique (14.9±5.1 mins). Pallath et al also observed shorter sensory onset time with double point injection technique (7.47±1.78 mins) than single point injection technique (9.79±1.6 mins) and motor onset time with double point injection technique (10.49±2.02 mins) than single point injection technique (13.37±4.21 mins).

the mean time to achieve complete sensory block was 15.83±0.76 minutes in group SP and 10±0.76 minutes in group DP and time to achieve complete motor block was 21±0.78 minutes in group SP and 15.85±0.75 minutes in group DP. Pallath et al found the same results.

The mean time of duration of motor block was (259.33±20.95 mins) in group SP and (306.33±10.33 mins) in DP and the mean time of duration of sensory block was (313.33±12.94 mins) in group SP and (360.66±12.01 mins) in DP. The reason for longer duration of block effect could be an even distribution and systemic absorption of the local anaesthetic solution.

Choudhary et al found the same results. *block success rate* was significantly high in group DP.

In group SP among 30 patients; 24 patients had complete block effect and 6 patients had incomplete block effect resulting in 80% of success rate. In group DP among 30 patients; 28 patients had complete block effect and 2 patients had incomplete block effect resulting in 93.4% of success rate.

No case of failed block was reported in either group in our study. There are certain anatomical factors which may result in incomplete or failed block; Presence of septate barriers around the plexus prevent uniform spread of drug. The injected drug volume preferentially spreads to areas of least resistance and may not necessarily reach all the nerves of the brachial plexus in a sufficient quantity to produce effective blockade. In our study, Ulnar nerve sparing was the most common cause that resulted in incomplete block.

Our findings in this matter agree with Choudhary et al, who observed 96.6% of success rate with double point injection technique and 83.33% with single point injection technique.

Choi et al, also observed higher success rate with double point injection technique 94% as compared to 67% success rate with single point injection technique. Based on the findings observed by Choudhary et al, one can limit the total drug volume to 20 ml and obtain the desired results.

Limitations of our study were small sample size and inclusion of only ASA I and II patients, however, ultrasound guided supraclavicular block can safely be performed in high-risk cases in emergency setting. Concurrent use of nerve locator with ultrasound can minimize the incidence of nerve injury and addition of adjuvants to local anaesthetic can prolong the duration of anaesthesia and analgesia.

5. CONCLUSION

The double point injection technique of ultrasound guided supraclavicular block has higher success rate in terms of blocking of all four nerves with faster onset and prolong duration of motor and sensory block at the cost of longer procedural time.

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7. Conflicts of interest: None.

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